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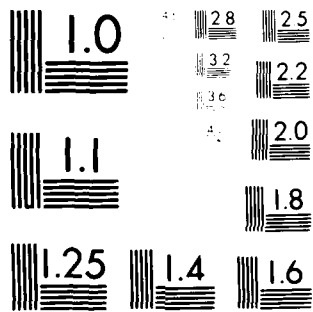
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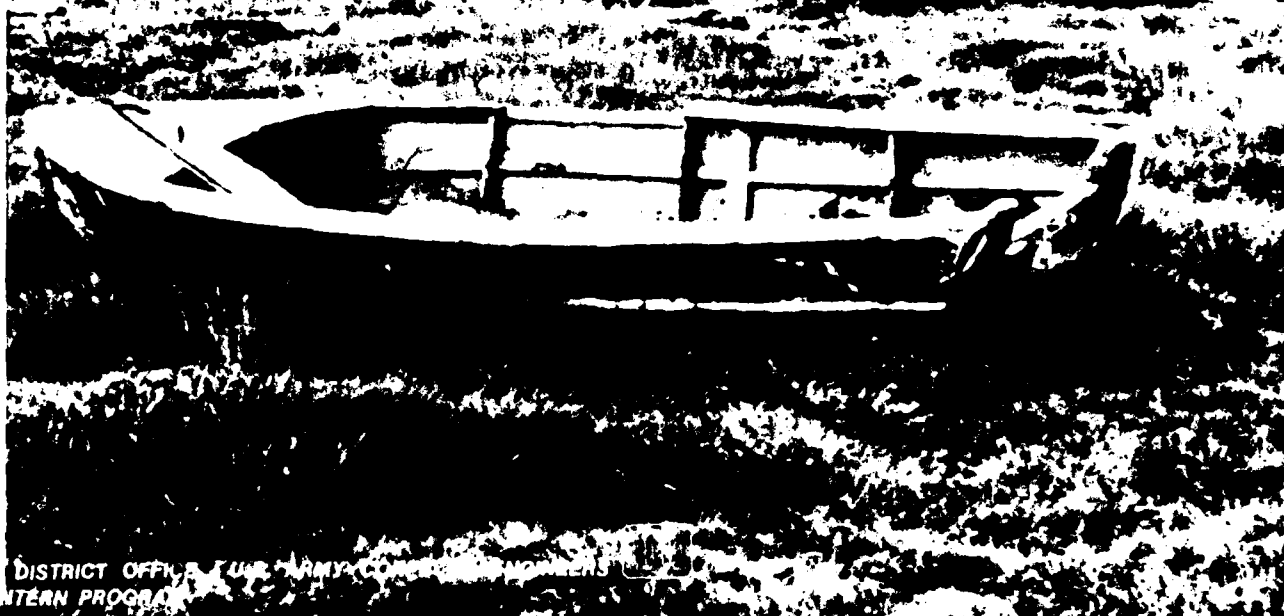
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FISH AND WILDLIFE MITIGATION:
An Introductory Analysis of the Concept and
Its Importance in the Management of Estuarine Resources

by:

Daniel M. Ashe

Supported by:

Seattle District Office
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Abstract

Applied effectively and consistently, the concept of fish and wildlife mitigation can be used to internalize the environmental costs of developmental activity and to fit desirable economic activity compatibly into the estuarine environment. To date, however, many resource managers are dissatisfied with the progress and success of the concept as it is widely misunderstood and misapplied. This paper will introduce the reader to the broad management concept of mitigation, its utility in fish and wildlife conservation, and how it may be most effectively applied within estuarine environments. The critical questions of extent or degree (i.e., how much to mitigate) will be addressed as will the question of how to mitigate estuarine losses. The paper is intended to provide a broad and conceptually oriented overview of mitigation and to draw conclusions concerning the need and potential for development of estuarine-specific policy at the Federal level.

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Introduction

Mitigation is a management concept which is applicable within a wide array of disciplines. Examples of its interdisciplinary application are found within the fields of land use planning, coastal energy facility siting, residuals (i.e., waste) management, and fish and wildlife conservation to name only a few. However, effective use of mitigation as a management tool within each of these disciplines will require a unique conceptual and institutional (i.e., policy) framework. This paper will focus on the use of the concept of fish and wildlife mitigation within the context of estuarine management. Applied and enforced consistently, this concept can be used to effectively offset the adverse effects of estuarine development.

When asked to define the term mitigation, most people tend to use adjectives such as lessening, reducing, or minimizing. According to "Webster's New Collegiate Dictionary," such a response is not necessarily lacking in accuracy:

mitigate. 1: to cause to become less harsh or hostile;
mollify. 2: to make less severe or painful (Webster's, 1979).

However, accuracy in defining the term mitigation is not the objective of this paper. Rather, its objective is to describe and define the concept of mitigation as it relates to the conservation of fish and wildlife and as it may be most effectively applied within the estuarine environment.

Fish and wildlife mitigation has not, as yet, evolved into much more than an ill-defined process whereby developmental impacts are either reduced or offset. Horak and Olson (1980) have described Federal project mitigation as a complex, multifaceted process which, in its simplest form, consists of three steps:

- a. "Formulation of fish and wildlife (mitigation) recommendations by state and Federal fish and wildlife agencies.
- b. Bargaining for a (mitigation) measure acceptable to both the fish and wildlife agencies and the agency sponsoring a water resource development project.
- c. Implementation of the accepted (mitigation) measure."

Horak and Olson limited themselves to Federal water resource projects specifically, but this description is an adequate summary of the mitigation process in relation to other activities as well. Mitigation is a process of negotiation and, as implied in the description above, its success is dependent upon meaningful interagency coordination. Equally important, however, is meaningful interaction with local and/or private

project sponsors, as this is often the most difficult bargaining to achieve. This process of interagency and intersector negotiation is guided by the desire to conserve (i.e., use wisely) our nation's finite fish and wildlife resources. Mitigation, therefore, like regulation, planning, and preservation, is evolving as a valuable tool in this effort.

We find ourselves, however, at a critical juncture in the development and utilization of this concept toward the conservation of fish and wildlife resources; the rather straightforward questions of "if" and "why" mitigation is necessary have been answered at the Federal level and, in many cases, at the state level as well. The remaining questions of "how much" and "how" to mitigate fish and wildlife losses are proving difficult to answer, but are critical to the concept's effective implementation.

The need to "mitigate" development related losses of fish and wildlife is fundamental to the protection and maintenance of the resource, but mitigation, as a concept, is widely misunderstood and misapplied. Many believe that the concept's implementation has been unsuccessful and Jahn (1979) expressed this belief in an address to The Mitigation Symposium (Fort Collins, Colorado, July 16-20, 1979): "As applied in practice heretofore, mitigation has seldom amounted to more than post facto acknowledgement of some 'unfortunate' disruption. When it has been addressed ante facto, mitigation may have been little more than the sugar coating to render a bitter pill more palatable." Definitions like those offered by Webster are too general to be of any utility in applying the concept to fish and wildlife losses and interagency coordination may be inadequate, as the agencies often view one another as adversaries in the process of mitigation planning. The ultimate losers are the citizens to whom the resources belong. Dziedzic and Oliver (1979) illustrated the concern of the Washington State Department of Game as follows: "Mitigation as practiced now is a 'ripoff.' In effect, it justifies the destruction of public resources with public funds." Clearly, there is widespread dissatisfaction with the progress and success of the concept's utilization. Controversy over definition, related questions concerning the proper degree of mitigation (i.e., how much to mitigate), and the nature of "appropriate" mitigation (i.e., how to mitigate) form the basis of interagency conflict and are at the core of mitigation controversy. These are the issues which are to be addressed within this paper.

The three sections following this introduction will deal with the Federal authority and legal basis for fish and wildlife mitigation, the critical and complex question of how to adequately define mitigation when used in this context, and the reasoning behind a call for unique mitigation policy within estuarine areas. This discussion will provide a useful overview of the concept and will lead into the fourth section which will discuss and analyze a variety of approaches taken in mitigating estuarine losses. The final two sections will deal with the development of estuarine specific policy within the Pacific Coast States and

the use of dredged materials in mitigation efforts. This paper will illustrate the nature and range of conflict which confronts managers during mitigation planning, will indicate the relative value of various approaches to the concept, and will emphasize the need and potential to develop an estuarine specific policy at the Federal level.

The Federal Authority for Fish and Wildlife Mitigation

Mitigation is not a new concept and in divergent forms has been applied successfully for decades. Krulitz (1979) illustrated this fact:

"The process of mitigation, taken in its non-wildlife context, is, after all, fairly routine. Federal construction agencies have without question or quarrel accepted the responsibility of offsetting project impacts on property interests. Roads and powerlines have been rerouted, ranches, farms, resorts, and other businesses bought and paid for, entire communities relocated, all in the normal course of project planning and construction."

Unlike human and economic resources, however, it is generally impossible to provide for the physical relocation of fish and wildlife resources and due to the lack of an established economic market and the unsuitability of currently available pricing methodology, these resources cannot be simply bought or sold. Nonetheless, they should receive equal consideration. Mitigation of project-related fish and wildlife losses could, therefore, be viewed as a relatively recent and important application of the rather well-established and broadly applied concept of mitigation.

The fish and wildlife resources of the United States are common property, public resources, belonging to the citizens of the nation. These resources are held in trust by the Federal and state governments and must be maintained and protected for the unimpaired use of the public. In the interest of such maintenance, a mitigation authority and obligation has arisen within the Federal structure. Although there is no well-codified, formal policy on fish and wildlife mitigation that is applied and implemented consistently at the Federal level, this concept is evolving as a tool in the maintenance of our fish and wildlife resource.^{1/} This section will present and discuss the major components of the Federal authority which are the basis of a disperse and too often ineffective Federal policy on fish and wildlife mitigation.

^{1/}The exception to this lack of formal policy is the recently published (Federal Register, September 9, 1980) mitigation policy of the U.S. Fish and Wildlife Service (FWS). This draft represents the most thorough and conceptually sound policy statement made at the Federal level to date, but doubts concerning the ability of FWS to effectively and consistently implement this policy lead back to the statement made above.

a. The Fish and Wildlife Coordination Act (FWCA) of 1934. Mitigation, in relation to fish and wildlife resources, first appeared in the FWCA (16 USC Section 661, et seq.), but implementation of the concept did not follow and Krulitz (1979), in this respect, describes the FWCA as "an act which was premature." Substantial amendments in 1946 and 1958 have, however, transformed the FWCA into the prime Federal statute dealing with fish and wildlife mitigation. As amended, this act requires that fish and wildlife conservation be given equal consideration with other features of water resources development projects.

Through the 1946 and 1958 amendments, Congress granted the Federal construction agencies (i.e., agencies charged with development of the nation's natural resources as necessary to further the "public interest") the authority to incorporate fish and wildlife mitigation into the structure and operation of federally sponsored projects (16 USC Sections 662(b)(c)(g), and 663(c)). In fact, the FWCA contains a directive that project plans "shall: contain mitigation measures deemed justified by the construction or licensing agency" (16 USC Section 662(b)). Furthermore, the FWCA indicates what is to be the primary source of mitigation proposals. Under the FWCA, both pre and postauthorization planning, including mitigation, must be coordinated with the FWS and the concerned state fish and wildlife agencies (16 USC Section 662(a)). The FWS must prepare a detailed "fish and wildlife report" which identifies the measures proposed for mitigating damages to wildlife resources which are attributable to the project (16 USC Section 662(b)). This report is usually reviewed by all other Federal and state agencies expressing a concern.

While the FWCA establishes a definitive authority under which the Federal agencies can plan for and implement fish and wildlife mitigation, it does not state whether such mitigation must occur, or only that it must occur, when deemed justified by the licensing agency. Additionally, while providing a mechanism whereby mitigation recommendations are developed and agency views are solicited, the FWCA does not indicate upon whom is to be placed the burden of proof; apparently, however, resource agencies would be required to "convince" the constructing agency of the justifiability of mitigation measures. Therefore, although the FWCA is the basis of fish and wildlife mitigation, as it is known today, it could not, of itself, provide the authority necessary to successfully apply the concept.

b. The National Environmental Policy Act (NEPA) of 1969. NEPA (42 USC Section 4321, et seq.) forms the second major piece of Federal legislation dealing directly with mitigation. Although this act does not deal specifically with fish and wildlife resources, its provisions apply to all Federal agencies and all activities involving Federal monies. Paraphrased, NEPA requires that during project planning:

- (1) all practicable mitigation measures are studied,

(2) that these measures are included and reviewed in the environmental impact statement (EIS) process and

(3) the mitigation plans agreed to are carried out and effectively monitored by the lead agency.

Thus, NEPA specifically addresses the procedural aspects of the mitigation process. By mandating that mitigation proposals be incorporated into the EIS process, NEPA may have provided an avenue whereby fish and wildlife mitigation can become an inseparable part of the planning process and is considered concurrently with other planning functions. To date, however, this mandate has not been effectively enforced. Perhaps NEPA's most significant contribution is contained in the "Regulations for Implementing the Procedural Provisions of the NEPA," drafted by the President's Council for Environmental Quality (CEQ), where the burden of proof regarding the justification of mitigation plans is placed upon the lead agency (40 CFR Section 1502.2(c)). NEPA states that the sponsoring agency must indicate whether all practicable mitigation measures have been adopted and, if not, why they were not. Thus, NEPA compliments the authority granted within the FWCA with a requirement that all practicable mitigation be undertaken by the lead agency. Nonetheless, NEPA still does not specifically require that effective mitigation occur but only that the construction agencies explain any decision to forego mitigation. By adopting stronger language, it would be possible for NEPA to function more adequately in requiring that credible mitigation actually be undertaken. This would be an important function since there is a substantial difference between an authority to mitigate and a requirement to mitigate.

c. Presidential Water Policy Message of 1978. President Carter, in his water policy message of 1978, supplemented the NEPA requirement that mitigation be undertaken in relation to federally sponsored projects. This message directs the Federal agencies to recommend for authorization only those projects which contain funding for mitigation which is "concurrent and proportionate with construction funding." This statement should provide additional direction to the mitigation process and it has been recommended that the FWCA be amended such that the President's policy message is legislatively secured (Rappoport, 1979).

d. The Common Law. Krulitz (1979), LaRoe (1979) and Thararrat, et al. (1980) suggest that common law doctrines may provide some additional mitigation authority in relation to the prevention of damage to publicly owned fish and wildlife resources. Common law is that which is not defined in statute but which has evolved through judicial precedence and is defined in case law. This authority is much less distinct and direct than those above but may be relative to mitigation in providing the authority for the prevention of public nuisance and maintenance of the public's right to gain access to and enjoy the nation's environmental resources. Common law doctrines may provide not only additional authority but also an enforceable obligation to mitigate fish and wildlife

losses. An important example of such an obligation - within the estuarine environment - will be discussed in a later section.

Collectively, the various authorities presented above reflect the general ideology that fish and wildlife values and the mitigation of fish and wildlife losses must be considered within the Federal decisionmaking process. The Federal legal background provides both the authority and the obligation to successfully apply the concept of fish and wildlife mitigation. Hence, the directive to mitigate (i.e., the questions of "if" and "why") has been clarified and the concept itself is rather non-controversial. The Federal background does not, however, adequately address the degree, extent, or nature of mitigation required and this has been the source of continuing controversy.

Defining Fish and Wildlife Mitigation

To this point, fish and wildlife mitigation has been defined only in a broad, conceptual manner as a process whereby development-related impacts are either reduced or offset. This, however, is more a description than a definition and it leaves the critical issue of degree (i.e., how much mitigation is necessary) open to interpretation on a case-by-case, agency-by-agency basis. Failure to proceed beyond such conceptual descriptions to a workable and widely acceptable definition has been a major factor in preventing the successful utilization of this concept.

Within the process of implementing the mitigation provisions of the NEPA and the FWCA, attempts at resolving disputes over definition have been undertaken. The "comprehensive" definitions resulting from this process provide a good point from which to begin a discussion on defining fish and wildlife mitigation.

a. The NEPA (CEQ) Definition. The President's CEQ, in formulating the "Regulations for Implementing the Procedural Provisions of the NEPA" (40 CFR Section 1500 et seq.), has defined terms which are to "be uniform throughout the Federal government" (40 CFR Section 1508.1). Section 1508.2 of the CEQ regulations states that "mitigation includes:

- (1) avoiding the impact altogether by not taking a certain action or parts of an action;
- (2) minimizing impacts by limiting the degree or magnitude of the action and its implementation;
- (3) rectifying the impact by repairing, rehabilitating, or restoring the affected environment;
- (4) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action;

(5) compensation for the impact by replacing or providing substitute resources or environments."

Thus, as stipulated within the NEPA (CEQ) regulations, mitigation refers to any of a variety of actions designed to prevent, reduce, or offset disruptions to the natural environment; such action may entail the simple denial of a permit (avoidance), lessening the size of a wetland fill anywhere from 1 to 99 percent (reduction), or offsetting the loss by restoring the productive capacity of a previously altered wetland area (compensation).

The most striking characteristic of the NEPA definition is its broad, all-inclusive nature; mitigation involves avoiding, minimizing, rectifying, reducing, eliminating, or compensating. Due to its generality, this definition is of limited value at the field level and cannot be expected to significantly enhance implementation of fish and wildlife mitigation measures. NEPA, however, in forming the nation's basic character on environmental quality, may be justified in adopting this general definition. As mentioned previously, the provisions of NEPA are applicable to all Federal activities and all environmental resources. The fish and wildlife resource, therefore, is only one of many to which NEPA is applicable. Others may include physical, social and economic resources and these may require a different approach to the concept of mitigation. Thus, the NEPA definition must be sufficiently comprehensive and general in order to allow for interdisciplinary and interagency flexibility.

b. The FWCA Definition. It is the FWCA, an act which focuses upon fish and wildlife conservation, which should contain a concise and workable definition for fish and wildlife mitigation. The proposed FWCA definition is stated within the "Notice of Proposed Rulemaking" (50 CFR Section 410.3), a joint effort by the Departments of Interior and Commerce. While this document appears to take a more pragmatic approach to the definition, it does, in actuality, offer little more than a paraphrasing of the NEPA (CEQ) regulations:

"'Mitigation' means (a) lessening wildlife resource losses to a project through loss prevention measures and (b) offsetting losses through the use of other structural and nonstructural measures.

'Loss Prevention' means designing and implementing a project to avoid adverse impacts upon wildlife resources.

'Compensation' means completely offsetting losses to wildlife resource values using measures described in the NEPA regulations. 40 C.F.R. Section 1508.2."

While this definition distinguishes loss prevention from compensation, it clearly identifies both of these as forms of mitigation. Under the FWCA definition, mitigation could entail avoiding, lessening, offsetting, or completely offsetting. Thus, as with the NEPA definition, the

FWCA definition apparently fails to address the issue of degree and is too broad to give any substantive guidance at the field level. While many have interpreted the proposed FWCA definition as one which calls for both loss prevention and compensation, the language used is too weak to ensure that this is a common interpretation. The result, of course, is an increase rather than a decrease in controversy over degree. Unfortunately, broadness and lack of specificity and clarity are less justifiable within the FWCA than within NEPA, since, as stated above, the former deals specifically with fish and wildlife conservation. Fortunately, as indicated previously, this is a proposed definition, not yet operational and still open to amendment. It has been indicated, however, that this definition will not be altered significantly (Comstock, 1980).

c. Fish and Wildlife Mitigation: A Resource Specific Definition. In their attempt at comprehensiveness, the two efforts discussed above (NEPA and FWCA) have done little more than elaborate upon the conceptual description mentioned earlier - a process whereby impacts are either reduced or offset. Although CEQ's need to develop a broad, generalized definition is recognized, it is unfortunate that this definition is to be applied uniformly throughout the Federal Government rather than acting as a uniform guideline for the development of resource-specific definitions. As is indicated by the contradictory and largely impotent FWCA definition, attempts to apply CEQ's definition, uniformly, to agencies dealing with different resources and considering different factors and constraints will serve only to further burden the process of mitigation and exacerbate controversy over degree. Such definitions can offer little guidance to the agencies in determining how much mitigation is necessary and hence, conflict, inconsistency, and confusion can be expected to continue.

Since all-encompassing definitions are incapable of providing a solution to the mitigation controversy, the agencies involved should view the NEPA definition as a guideline subject to expansion and interpretation. Subsequently, agencies commonly interacting in the management of particular resources should collaboratively develop resource specific definitions which clearly indicate the degree of mitigation to be required. It is a contention of this report that losses to fish and wildlife resources, which are attributable to human activity, should be offset completely, given the constraints of current analytical and technical capabilities, by moving to a compensation philosophy of mitigation. The following resource-specific definition will be applied within this paper:

Fish and wildlife mitigation is a process involving the development and implementation of specific actions which are designed to compensate for the unavoidable^{1/} losses of fish and wildlife resources accruing as a result of human activity.

^{1/}Unavoidable losses are defined as those "resultant" losses which persist after good, thoughtful, and thorough planning has taken place; they may be losses which are not preventable or amenable to planning or which, as a result of a policy decision, have been sanctioned as an "unavoidable" or "necessary" project-related impact.

As this definition implies, the terms "mitigation" and "compensation" will be used synonymously within this report, as mitigation (hereafter, "mitigation," unless otherwise specified, will refer to fish and wildlife mitigation) is considered to be an effort to compensate (i.e., completely offset) project-related impacts.

Individuals on both sides of the mitigation issue should realize that mitigation is neither an attempt to, nor a means of, preventing necessary development or pursuing a policy of zero growth. In order to support desired economic growth, some alterations of the "natural" environment must take place and while mitigation should be an attempt to compensate for the adverse effects of these alterations, this may be infeasible in certain cases (several examples will be presented in the following section). Adoption of an explicit definition, such as that above, will, however, help to ensure that such cases are the infrequent exception rather than the general rule.

d. Defining an Objective for Fish and Wildlife Mitigation. The Federal policy on fish and wildlife mitigation is so dispersed that no specific goal or objective is evident. While attempts have been made to define mitigation, there has been little, if any, emphasis placed upon the formulation of a mitigation goal. The ultimate objective of the mitigation process should be to maintain the nation's fish and wildlife resources while accommodating necessary economic activity and this objective - focusing upon the maintenance of the resource - should form the cornerstone of a Federal policy on mitigation. Admittedly, this is a broad statement of purpose, but in providing definitive guidance, it would represent a significant departure from the current situation. In certain cases, more specific goals may be appropriate and thus, this objective should be expanded and refined in order to suit resource or system-specific needs.

In determining how to mitigate losses of fish and wildlife, mitigation planners must make a fundamental decision regarding the nature of mitigation efforts. Mitigation can be either:

- (1) in-kind: involving resources which are similar to those being altered and which play similar roles in ecosystem function; or
- (2) out-of-kind: involving resources which are dissimilar in any number of characteristics; and either
- (3) onsite: occurring on, adjacent to, or in the immediate proximity of the development site; or
- (4) offsite: occurring at a point distant from the project site but within the specific system or area involved.

Mitigation planners, therefore, must consider each of four mitigation options illustrated in the matrix below:

	In-Kind		Out-of-Kind
Onsite	In-Kind (A) and Onsite		Out-of-Kind (C) and Onsite
Offsite	In-Kind (B) and Offsite		Out-of-Kind (D) and Offsite

Many have expressed the belief that mitigation goals should offer explicit guidance regarding these options and in this respect, goals such as no in-kind loss of habitat or habitat value have often been proposed. Such goals, however, may represent an oversimplification of an extremely complex issue.

Although there is probably general agreement that option A (in-kind, onsite) is most preferable and option D (out-of-kind, off-site) is least preferable from an ecological perspective, the mitigation planner would need to consider cost and feasibility considerations as well as ecological ones. Furthermore, in-kind mitigation may not always constitute the most ecologically preferable alternative, as other factors (e.g., restoring habitat diversity) may warrant the use of out-of-kind alternatives. Mitigation goals, therefore, should not be specific to the point that they are restrictive, while in-kind and onsite considerations may indicate which site is most capable of developing and functioning in a manner similar to the development site; the mitigation plan chosen must be sensitive to system-wide management objectives (e.g., restoration of habitat diversity). For this reason, the nature of mitigation efforts (i.e., in-kind, onsite, etc.) to be undertaken should be indicated in a set of implementing guidelines rather than "preset" into a statement of purpose. Such policy will help to ensure that project-specific losses are successfully mitigated within the context of system-wide management objectives.

It is important that the development of mitigation policy, at any level of government, be inclusive of a specific objective which is capable of lending direction and consistency to the process. The mitigation objective mentioned above (i.e., maintenance of the resource) should be viewed as a general guideline which can and should be expanded and refined as it is applied within different systems. However, attempts to "refine" the objective downward to a less demanding form (e.g., minimize losses) or to adopt restrictive language requiring in-kind or onsite mitigation will diffuse the overall effectiveness of mitigation in maintaining fish and wildlife resources and should be discouraged.

This section has intended to clarify the necessity that concise and explicit definitions and statements of objective be set forth to guide the process of mitigation at any level of government. This recommendation is of particular relevance at the Federal level where policy is virtually nonexistent, definitions are inexact, objectives are unclear, and guidance is incomplete or absent. The definition and goal suggested herein should be viewed as examples of the type of explicit policy elements that are needed to provide this guidance. If implemented, a definition such as that offered above would have several significant implications upon mitigation as it is commonly practiced today; policies such as no action (avoidance), good planning (prevention), and simple acquisition (preservation) would not constitute mitigation. Although such exclusions may be counter to the current mindset of construction, planning, and even resource agencies, it is the opinion of the author that they would be useful exclusions. The following sections will test the validity of this hypothesis, within the context of estuarine management, by evaluating a variety of approaches to estuarine mitigation.

Estuarine Mitigation: A Need for Ecosystem-Based Policy

In a recent series of recommendations to the Office of the Chief of Engineers (OCE), OCE's Environmental Advisory Board (EAB) made the following comment:

"The Corps should approach the opportunity for mitigation in certain areas of the country on an ecosystem basis. It should examine the possibility for mitigation regionally, and articulate policies that are best suited to present and compensate for losses."

This is a recommendation of relevance to all agencies involved in the mitigation process. An important opportunity to apply such a recommendation exists within the coastal and especially estuarine areas of the nation.

An ecosystem has been described by Odum (1971) as all of the biotic elements (i.e., species, populations, and communities) and abiotic elements (i.e., land, air, water, and energy) interacting in a given geographic area, such that a flow of energy leads to a clearly defined trophic structure, biotic diversity, and materials cycle. This concept, therefore, considers the ecosystem (e.g., an estuary) to consist of a series of interrelated biotic and abiotic components which function, in concert, to produce a flow of matter and energy - the food chain. This concept has led, in large part, to the management theory that damage to the ecosystem in one area can be mitigated by constructive or restorative efforts in another area (proximate or distant). By emphasizing the maintenance of major processes and components of the estuary, an ecosystem approach toward mitigation can help to simplify a rather enormous natural complexity and to ensure that the system continues to function. Additionally, a specific ecosystems approach toward estuarine mitigation, including the development of ecosystem-based policy, will be more

sensitive to the unique characteristics, needs, and opportunities that may be presented by the estuarine environment. This section will identify some of these characteristics, needs, and opportunities and how ecosystem-based mitigation policy may be more sensitive to them and, thereby, more effective.

a. Estuarine Value and Vulnerability: The Need for Innovative Policy. Estuaries, via their aquatic, intertidal, and wetland components, generate a wide array of benefits for both human and wildlife communities. These unique systems provide an abundance of fish and wildlife habitat which is essential in the life cycle of many economically important species and which forms the basis of an enormous biological productivity. Moreover, estuarine systems retain and cycle nutrients, filter the waste products of human society, retain runoff and recharge freshwater aquifers, provide barriers to saltwater intrusion, buffer adjacent land areas from the force of the sea, and moderate extremes in both air and water temperature. Healthy estuarine systems can provide benefits to not only indigenous and immediately adjacent communities but may also contribute to the well-being of human and wildlife communities in coastal areas distant from the estuary itself; the estuary is truly a resource of regional and national, as well as local, significance.

Estuarine environments are magnets for both human and wildlife activities, but these activities are not always compatible and are, at times, completely conflicting. In general, the habitat value of estuarine areas has suffered as a result of human actions and nowhere is this more evident than in California's coastal areas. Excluding San Francisco Bay, where the most extensive alteration has occurred, 52 percent of California's original coastal wetlands have been destroyed by dredging and filling and 62 percent of the remaining wetlands have been subject to severe damage (California Coastal Plan, 1975). While estuarine ecosystems are resilient and possess some ability to adjust to alteration, threshold levels have most probably been reached or exceeded in the majority of cases and future development will, inevitably, occur at the expense of the productive capacity of estuarine environments.

Given their tremendous economic value, the incessant demands placed upon them by human society, their limited geographic occurrence, and finite boundaries, estuarine systems present a great urgency for a well coordinated, innovative application of the mitigation concept. Too many of our estuarine values have been lost, but although estuarine environments will continue to function and develop as industrial, commercial, navigational, residential and recreational hubs, these activities must fit, compatibly, within the estuarine system. Precisely defined and strictly enforced mitigation can aid in the prevention of further degradation of these unique and valuable ecosystems.

b. Estuarine Mitigation: Enhanced Opportunity. An ecosystem-based mitigation policy should be sensitive to the mitigation opportunity

posed by the particular system and this opportunity may be as much a function of the impact encountered as of the characteristics of the system itself. LaRoe (1979) has illustrated the difference between impacts typical of coastal and inland systems; "in coastal waters the greatest impacts result from dredge and fill, while in inland areas, they are the result of dams and diversion projects." It is this difference, in conjunction with the characteristics of the estuarine system, which may result in substantially divergent opportunities for mitigation in coastal and estuarine, as opposed to inland, environments.

Dredge and fill activity within estuaries has resulted, traditionally, in the loss of wetland and shallow intertidal habitat. These areas are vital components of the estuarine ecosystem and their loss is translated into a reduction in the functional capacity of the estuary and in total, systemic productivity. The estuary continues to function, albeit, in a reduced capacity. Rarely, if ever, would any single human activity result in the destruction of an entire estuarine ecosystem. Thus, estuarine mitigation usually amounts to an effort to replace some functional component of the estuary rather than the ecosystem as an entity and as a result, compensatory mitigation will generally be more feasible within estuarine environments.

By employing one or any combination of the approaches to be discussed in the following section, it is possible to restore or replace estuarine wetlands, water surface area, and productivity and compensatory mitigation is feasible within the estuarine environment. This option, however, may often be inaccessible in conjunction with inland projects where development is often of a scale and nature which virtually precludes replacement of those resources lost or altered. Undoubtedly, some form of compensation will be plausible in most instances, but it is difficult and at times impossible to replace destroyed ecosystems; inundated trout streams or excavated bass streams may be examples of the impossibilities (Greenwalt, 1979). Moreover, it is often difficult to replace inundated terrestrial habitat without making tradeoffs involving the filling and transition of aquatic or marine habitat to upland, terrestrial habitat. Such transition is usually considered to be unacceptable.

As a result of this characteristic difference in impacts encountered within estuarine and inland areas, the range of mitigation options available will generally be more complete within estuarine environments. Thus, the opportunity to successfully mitigate fish and wildlife losses should be greater in estuarine than in inland areas and the variety of options available to both public and private developers will be more diverse.

c. Broadened Authority for Estuarine Mitigation. Perhaps the most substantive difference between the mitigation of fish and wildlife losses in estuarine and inland areas is in the authority to require and implement mitigation. The mitigation provisions of the FWCA and NEPA,

discussed above, apply to Federal and federally sponsored projects within each of these areas and the basic implementing authority is the same. It is within coastal areas, however, where the authority to require mitigation of impacts resulting from privately funded development has been firmly established.

The regulatory program of the Corps has evolved under the Rivers and Harbors Act of 1899 and the Federal Water Pollution Control Act (Clean Water Act), as amended in 1977. Under Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act, the Corps regulates construction in wetlands or of that which affects the course, condition or capacity of navigable waterways - including environmental condition and biological capacity (Banner, 1979). Regulation is in the form of a permitting process and in compliance with the coordination act, FWS is consulted regarding its concerns over issuance of a permit. Under FWS regulations, mitigation may be required before the agency will consent to the granting of the permit (Fish and Wildlife, 1975). While the Corps is not mandated to concur with FWS proposals, these proposals are given great weight and permits may be conditioned to include necessary mitigation. In reality, the Corps rarely conditions permits, claiming that it lacks enforcement authority, but often elects to take no action until differences between FWS and the applicant are resolved. Therefore, theoretically, it is in the applicant's own best interest to comply with FWS proposals.

The combined authority of these two acts allows the Corps to regulate virtually all construction activity within coastal waters and their adjacent wetlands. Since the large majority of coastal wetlands are privately owned, this authority is critical to the maintenance of the ecosystem. The ability to require mitigation in "small," private developments will, theoretically, allow long-term, cumulative impacts to be avoided. Thus, in effect, the Corps' Regulatory Program significantly broadens the authority for mitigation within coastal and estuarine environments.

In addition to this broadened authority, La Roe (1979) has suggested that the public trust doctrine provides an obligation to those involved in the mitigation process to be more rigorous in efforts at mitigation within coastal wetlands. "This doctrine, founded in common law, asserts the public's right to unimpaired use of the tidal waters for navigation, for fish and wildlife production and for recreation (La Roe, 1979)."

The estuarine environment presents the urgency, opportunity, authority, and obligation necessary to be more rigorous in applying the concept of mitigation. This statement emphasizes the relevance of the EAB recommendations mentioned earlier; in dealing with estuarine mitigation, the Corps and all involved agencies should elevate their thoughts and actions to the ecosystem level. These agencies should design policy which is sensitive to the unique nature of estuarine mitigation and encourage and aid in the development of ecosystem-based, regional mitigation policy. The overall objective of estuarine mitigation should

be to maintain the benefits which the estuarine system provides to both human and wildlife communities. Due to the overwhelming complexity of these unique environments, however, it is often difficult, if not impossible, to determine what estuarine properties are responsible for the generation of these benefits. In accordance with the ecosystem theory, it may be possible to mitigate project-specific impacts by emphasizing replacement and maintenance of critical ecosystem processes and components. Designed and implemented on an ecosystem basis, mitigation efforts will be sensitive to system requirements and more effective in maintaining the nation's estuarine resource.

What Is (or Is Not) Mitigation: A Study in Estuarine Precedent

In conjunction with the development of this nation's estuarine resources, myriad activities have been undertaken in the name of mitigation. Many of these activities, however, may not constitute mitigation at all and are oftentimes designed to mollify project opponents rather than project-related fish and wildlife losses. This section will attempt to evaluate the effectiveness of a variety of precedential approaches to mitigation within the estuarine environment. The fact that the focus of this paper is on the estuarine environment, however, should not be construed to mean that these exclusions are of utility only within such systems. Attempts will be made to give the reader a basic introduction to each approach, to present its advantages and disadvantages from both a developmental and environmental perspective, and to identify some of the limitations to effective implementation of the approach. The order of presentation is intended to generally represent the author's conception of the relative value (from least to best) of these approaches in mitigating fish and wildlife losses. While this is not intended to be an exhaustive, comprehensive, or highly technical presentation, it should provide the reader with a general background regarding manners in which the concept has been applied and misapplied and leave him/her with some understanding of how the concept may be more effective in mitigating fish and wildlife losses within all environments.

a. A Regulatory Approach. The initial discussion of this section will center around what may be defined as the regulatory approach toward mitigation. The use of this approach, as well as the "good planning" approach to be discussed subsequently, has been encouraged by the ideology implied within the definitions of NEPA and the FWCA: that mitigation is an all-encompassing, omnibus process, inclusive of any action which results in a reduction of impacts. Under such definitions, purely regulatory functions can be and are considered to constitute mitigation and one could expect to find items such as "modifying the project to avoid impacts upon critical wetland areas" being proposed as mitigation. In fact, however, critical wetlands should be avoided as a part of normal agency policy under the guidance of Section 404 of the Clean Water Act and Executive Order (EO) 11990 (EO on wetlands). This approach, therefore, appears to have been the result of a basic misunderstanding of the concept of mitigation and of the fundamental difference between the related objectives of regulation and mitigation.

The objective of regulatory activity is to avoid unacceptable environmental effects by ensuring that human activity occurs in a suitable site and proceeds according to specified standards. In contrast, mitigation, as defined earlier, is an attempt to address and offset losses which are expected to accompany development activity.

Many may argue that this is not an issue of substance since both are attempts to reduce impacts, but widespread use of the regulatory approach has only served to exacerbate mitigation problems. It is this ideology which has enabled construction agencies and private developers to receive "mitigation credit" for activity that is undertaken to fulfill regulatory requirements rather than to mitigate project-specific losses. Why this ideology has been accepted by the resource agencies is unclear, but it may be seen as a method of relieving the oftentimes onerous burden placed upon these agencies to formulate defensible mitigation options. Thus, while individuals on both sides of developmental issues have encouraged the use of a regulatory approach, they appear to be motivated more by factors of convenience than by interest in offsetting project losses. There is, therefore, a useful and fundamental distinction between that which is regulation and that which is mitigation, and failure to recognize this distinction can significantly alter the success of mitigation efforts in maintaining fish and wildlife resources. As a result, permit denial (no action) and other regulatory actions which result in the avoidance of loss should not be credited as mitigation.

b. The Good Planning Approach. An approach which is even more fervently embraced by many of those involved in the mitigation process and which has gained widespread use is often referred to as the "good planning" approach. The formal goal of a planning approach to mitigation appears to be the prevention of loss; this is a process which addresses unnecessary alteration or destruction of fish and wildlife resources and, through innovative planning, results in the formulation and refinement of development alternatives which prevent such commitments. Thus, planning and preventative conservation are methods whereby ameliorative activities are built into the decisionmaking process. Greenwalt (1979) described the results of this process as "factory installed options" and planning, therefore, is a method of addressing and eliminating unnecessary environmental degradation. However, not all impacts can be planned away and in the interest of maintaining the estuarine resource, it will, almost without exception, be necessary to go beyond good planning; this is the realm and purpose of mitigation and, as in the preceding case, there is an important distinction between planning and mitigatory functions.

As mentioned above, many development-related impacts are unavoidable and it is this term which forms a distinct and important boundary between planning and mitigation. This distinction is of significance to all fish and wildlife mitigation, but it is quite evident within wetland

environments. Corps' policy (30 CFR Section 320 et seq.) considers wetlands to be "vital areas that constitute a productive and valuable public resource, the unnecessary alteration or destruction of which shall be discouraged as contrary to the public interest." The Corps of Engineers and its "coordinating agencies," at both the Federal and state level, are mandated to avoid superfluous wetland alteration through far-sighted planning, in conjunction with any activity in or affecting wetlands. In the course of project and mitigation planning, therefore, these agencies should bear in mind the distinction between unnecessary and unavoidable degradation. Planning is a separate responsibility from mitigation; good planning is a normal project feature, designed to eliminate unnecessary impacts; mitigation is a corrective measure, designed to compensate for the unavoidable loss of public resources.

This is not merely an argument of a semantic or accounting dimension. Failure to make the distinction mentioned above may lead one to the rather absurd conclusion that any development includes mitigation, regardless of the magnitude of impact or degree of consideration given to wildlife resources, as long as there is a conceivably more damaging alternative from a wildlife perspective (Farmer, 1979). Additionally, failure to differentiate planning from mitigation may allow developers to circumvent any substantive mitigation effort through the use of good developmental strategy. By purposely designing their initial development proposal to be excessively disruptive and subsequently "planning" to reduce those impacts, developers can appear to make substantial concessions in the name of mitigation. Such concessions, however, are only gratuitous and do not, in any fashion, compensate the public for resources altered or destroyed. Once again, the resource agencies appear to have relied upon this approach as a matter of convenience. First, by making recommendations such as "scheduling dredging activity to minimize impacts upon anadromous spawning activity", these agencies can attempt to disguise a paucity of innovative and effective mitigation proposals. Admittedly, such proposals may often seem to be nonexistent, but the first step toward reaching a solution is to realize the shortage of options, not to disguise it. Secondly, agencies have further incentive to consider good planning as mitigation, in that in so doing, mitigation funding can be applied toward normal planning functions. The net result, of course, is less mitigation.

Good planning is an invaluable project component, but cannot, of itself, fully account for fish and wildlife losses. Good planning is a method of making development projects more efficient by preventing the waste (i.e., unnecessary loss) of fish and wildlife resources. Many times, however, losses will be unavoidable; mitigation is a method of accounting and compensating for these losses. Thus, while good planning (including the prevention and elimination of excessive or unnecessary degradation) is a useful tool in the conservation of fish and wildlife resources, it should not be credited as mitigation.

c. The Public Use Approach. The term "public access" is one which has recently come of vogue. This is especially true within coastal and estuarine areas where the right of the public to gain access to and enjoy publicly owned resources has been firmly established in common law. In the wake of an acute interest in providing such access, a public use approach to fish and wildlife mitigation has been applied rather ubiquitously. Its foundation lies within the following corollary:

Development activities, resulting in fish and wildlife losses, represent a loss in public use opportunity or potential and these losses may be "mitigated" by providing alternative public use opportunities.

Coastal development, for instance, may effectively reduce the ability of coastal systems to support public use by reducing the biological carrying capacity or esthetic quality of particular coastal systems. Whether such a reduction can or should be mitigated by providing for enhanced public access to the resource is the question which needs to be addressed.

Caminiti (1980) has described one case in which this approach was utilized. In a series of three fill projects from 1976 to 1979, the Port of Seattle significantly expanded its container storage capacity at the expense of 54 acres of Elliott Bay water surface. The Corps, Fish and Wildlife Service, Environmental Protection Agency and the Washington State Departments of Game and Fisheries insisted upon some form of "compensating mitigation." What the Port proposed and the agencies accepted, was a 2.5-acre public fishing pier.

This would not appear to constitute a just compensation for the public resources destroyed. While undoubtedly increasing the opportunity for public access, such actions fail to address either the impacts at issue (in this case, the loss of 54 acres of fish and wildlife habitat) or the system's ability to support an expanded public use. Such "mitigation," therefore, without even directly addressing those impacts for which it portends to compensate, does little more than to provide increased access to a dwindling resource. Admittedly, a properly designed fishing pier will be of some habitat value to fish and benthic organisms. It cannot, however, compensate for the loss of 54 acres of surface water and corresponding intertidal, benthic, and nektonic habitat. Without any defensible ecological foundation, a public use approach can be of no relevance to fish and wildlife mitigation. This approach amounts to nothing more than an arbitrary tradeoff and, in the case presented here, it has somehow been determined that a 2.5-acre fishing pier can justly compensate the public for the loss of 54 acres of estuarine habitat.

Development interests (both public and private) are the most obvious beneficiaries of a public use approach toward mitigation, as this avenue provides an inexpensive and uncomplicated method of fulfilling "mitigation" requirements; unfortunately, it is also ineffective. Local and state governments are often eager to accept such mitigation proposals as a method whereby public access objectives may be pursued, but while the

provision of public access is a desirable goal in itself, such objectives should not be subsidized at the expense of public resources by pursuing them in the name of fish and wildlife mitigation. Furthermore, state and Federal agencies often appear reluctant to spend public dollars on fish and wildlife (mitigation, enhancement, etc.) without ensuring that the public will have access to resources thus improved. Such access, however, should not be considered an integral part of the mitigation efforts but rather, as a supplement to them and should receive separate funding. Although the public use approach has been applied ubiquitously in the past, it is unable to ensure maintenance of the estuarine resource and its continued use can serve only to subsidize other social and economic objectives at the expense of increasingly scarce and valuable wildlife resources. Thus, its further use in mitigating estuarine losses should neither be promoted nor accepted.

d. The Acquisition (i.e., Preservation) Approach. In its basic form, an acquisition approach to mitigation represents a tradeoff, wherein the loss or alteration of one area is "offset" by the acquisition and preservation of another, equivalent area. This particular approach has been applied quite frequently within coastal and estuarine environments as it has proven to be attractive to both developmental and environmental proponents; developers, in order to expedite their permit applications, have found that they can often comply with mitigation pressures by acquiring alternative habitats for wildlife use. This option, of course, involves only the initial costs of acquisition and thus, has been quite attractive to small-scale, estuarine developers. Environmental proponents, including the resource agencies and specialized interests, have, undoubtedly, seen this approach as a method of preserving vital wildlife habitat. Examples of such mitigation abound. For example, in conjunction with an Everett, Washington, coastal project, the Simpson Timber Company agreed to maintain a coastal marsh habitat, to which it held title, and eventually to donate that area to the city.

The question that should come to mind is whether such an approach actually constitutes mitigation at all, or whether it should, in fact, be termed preservation. Both of these are necessary and effective tools of conservation, but should not be considered as equivalents. Preservation is an attempt to identify and protect critical environmental resources, in this case, wildlife habitat. Mitigation, as earlier defined, is an attempt to identify and compensate for project-specific, fish and wildlife losses. Bare acquisition does nothing to return the affected system closer to the without-the-project situation but rather, simply attempts to protect remaining wildlife resources through preservation. Once again, as discussed in relation to the public use approach, mitigation is being used in pursuit of desirable, conservation-oriented objectives, but objectives which are unrelated to the mitigation of project-specific losses. Thus, an acquisition approach fails to address the losses associated with development activity and can only ensure that some vital habitat will be protected; this, however, is not mitigation but preservation and bare acquisition should not be accepted as a viable mitigation alternative.

e. Single-Purpose Mitigation. Since mitigation planning often involves interaction among a variety of strongly mission-oriented agencies, it is no small wonder that efforts have often been concentrated upon a specific or specific group of "key" species; such an approach has been termed single-purpose mitigation and its primary objective is to isolate and protect species which are important from a human use perspective. Ideal candidates, therefore, are the valuable commercial and game species such as the anadromous fishes and migratory waterfowl. This approach has, in the past, been relied upon repeatedly by the wildlife and construction agencies alike, because not only is single-purpose mitigation amenable to agency missions but it is responsive to technological, engineering solutions and, therefore, relatively noncomplex (in that outcomes are highly certain and quantifiable) and easily implementable. In the interest of mitigation, single-purpose fish hatcheries and ladders have been built and fish and game stocking activities have occurred concurrently with terrestrial and aquatic development. The estuarine environment, however, is no exception and although contemporary interest in maintaining the estuarine ecosystem has led to a general reduction in the use of this approach, single-purpose recommendations continue to appear.

A recent effort on the part of the Port of Tacoma, Washington, to build a boat basin and marina resulted in demands for single-purpose mitigation. The Puyallup Indian Tribe, economically and culturally tied to the salmon fishing industry, has called for a program of fishery enhancement to mitigate the destruction of intertidal and benthic habitat which is "of significant value to indigenous salmon populations (Hylebos Marina: Seattle District Corps of Engineers Permit Application 071-OYB-1-001201)." Thus, the previously mentioned tendency of Federal and state agencies to favor such proposals may often be reinforced by pressures from highly organized special interests. However, the assumption implicit within proposals such as that made, in this case, by the Puyallup Indians, is that a fish hatchery or rearing pen can effectively offset the loss of valuable estuarine habitat.

While the key species concept and single-purpose measures are not without merit in mitigating resource alterations of a single dimension, such solutions, applied within estuarine areas, usually address only one dimension of a multifaceted and complex problem. Admittedly, in certain cases, the problem itself may be largely single-dimensional (e.g., the blockage of anadromous fish runs) but in general, single-purpose mitigation measures tend to oversimplify complex, multidimensional problems. This tendency will often lead mitigation planners to maximize one or only a very few aspects of the system, to the exclusion of nonmarketable but critical processes, components, and features of that system. Within estuarine environments, single-purpose mitigation will generally fail to consider:

(1) Service flows such as the water storage and purification, nutrient storage and cycling, temperature modification, and esthetic values produced by wetland environments;

(2) Noneconomic but critical species such as the primary producers, which form the basis of system energy flows;

(3) Characteristic species and habitat diversities such as the ratio of "low" to "high" salt marsh, or of salt marsh to mudflat, both of which may bear an important relationship to system function; and

(4) Physical factors such as surface area, average depth and tidal prism, which may directly affect systemic productivity, energy flows, and circulation.

Thus, in grossly oversimplifying a complex estuarine system, single-purpose mitigation measures ignore the ecosystem concept and will lead, ultimately, to a general reduction in estuarine values and productivity. Furthermore, as with the Puyallup Indian proposal, a single-purpose approach will ususally result in a technological and energy consumptive solution; as a result, human society is forced to continually divert productive resources, in the form of dollars and energy, into the maintenance of a fishery; a "service" provided free of charge by the unaltered habitat. In current times, further reliance upon technological and energy-consumptive solutions is poor policy.

Overall, single-purpose measures are incapable of mitigating fish and wildlife losses accruing as a result of estuarine development. This includes efforts to mitigate losses by continually creating or restoring one type of "key" habitat (e.g., salt marsh, mangrove, or grassbed) to the exclusion of all others. It should suffice to conclude that mitigation efforts should not be responsive to only a single dimension of the problem but should attempt to compensate for the entire range of benefits which a particular habitat or ecosystem provides to man, as well as to fish and wildlife. Thus, the loss of intertidal, estuarine habitat cannot be mitigated by the construction of a salmon hatchery and if single-purpose, structural solutions are deemed necessary and appropriate mitigation, they should be considered only as a component of a comprehensive mitigation plan. Such a plan must also include other measures which are sensitive to nonmarketable benefits lost or altered and should be as self-sufficient and nonstructural as possible.

f. Indemnification (In-Lieu Payments). Clark (1979) has defined indemnification as a form of mitigation that implies monetary compensation for the loss of ecological resources. A hypothetical example would involve a payment to a public agency in exchange for the ecological damage caused by a particular development. In theory it sounds like a perfectly logical approach to take, one which attempts to establish an economic market for common-property, fish and wildlife resources. The objective is to price environmental resources like other natural resources and to build this cost into the developmental decision process.

There have been two basic approaches taken in applying this form of mitigation. The first approach involves nondesignated fees, where the mitigation payments are funneled into a general wildlife fund. The second approach involves designated fees, where the payments are "ear-marked" specifically for mitigation of those impacts for which the funds were collected. Since the use of nondesignated fees does not address the impacts at issue, it should not be considered a viable mitigation option. In this section, only the latter approach will be discussed, since it can, if applied within the proper framework, conform to the definition of mitigation proposed earlier (i.e. specific action(s) designed to compensate for project-related, fish and wildlife losses). Where applied, however, this approach has been highly controversial and has received severe criticism from environmental proponents.

Environmental "purists" have generally resisted the use of this approach, as they have resisted the use of effluent charges in controlling pollution, because they claim that these methods represent the granting of a "license" to destroy habitat or pollute air and water. Why it is preferable to simply give away "rights" to pollute air and water or to destroy fish and wildlife resources through the issuance of unconditioned disposal and developmental permits is unclear. One can only conclude that such individuals associate the dollar with some sort of environmental stigma and see indemnification as an attempt by the government to auction off our nation's environmental resources. This, however, is not a functional limitation to the use of this approach but one that can be overcome through public education.

The ultimate problem encountered in exacting the payment of dollar compensation involves the determination of the charge to be levied. How much are 10 acres of salt marsh or bottomland hardwood or grassland worth? This is indeed a difficult problem which has been largely ignored in applications of this approach. When indemnification has been used, the dollar value chosen has resulted from an arbitrary decision process and has rarely, if ever, reflected the full value of the resources lost. This, of course, has made this approach more attractive from a developmental perspective, as developers can pass the responsibility for mitigation on to a public agency along with those payments made in lieu of actual mitigation efforts; any additional funds necessary to offset losses must, therefore, be born by that agency.

This approach to fish and wildlife mitigation was utilized in relation to the construction of a biotreatment lagoon by the Georgia Pacific Corporation (Seattle District Corps of Engineers, permit 071-OYB-2-004368). This 1978 project involved the commitment of 38 acres of tideland within Bellingham Bay, Washington. Project-incurred losses were mitigated by placing \$200,000 in trust with the Nature Conservancy, to be applied toward the purchase of alternative habitats. Without making any judgment as to the adequacy of the mitigation effort actually undertaken, the dollar amount chosen appears to have been the result of an arbitrary decision process and not in any way representative of the actual value of the public resources lost. Charges set in this manner do

not reflect the entire range of benefits produced by the habitat subject to alteration and are incapable of funding an effective mitigation effort.

In order to provide for the effective mitigation of fish and wildlife resources, in-lieu mitigation payments should represent the replacement value of the habitat subject to alteration. That is, in order to provide just compensation for public resources destroyed, developers should be required to make payment which is sufficient to provide for replacement resources. Only in this manner can indemnification constitute mitigation as earlier defined and promote maintenance of the nation's estuarine resources. Hitch (1980) speaking on energy policy, has stated that "consumers of energy will find ways to conserve if, but only if, prices are equal to incremental or replacement cost." Consumers of fish and wildlife resources can be expected to act no differently. Effective conservation will not be forthcoming until all the costs of development are internalized into the developmental decision process. Mitigation, undertaken effectively, may be the ultimate means of internalizing such costs and given the proper framework, indemnification may be a viable mitigation alternative.

Within the context of estuarine management, the development of mitigation banks may provide a framework within which indemnification can be applied effectively. A mitigation bank consists of suitable mitigation sites which are purchased by local governments and which are improved or restored in advance of development activity. To fulfill mitigation requirements, therefore, development interests would purchase a number of "units" from the bank which would be capable of compensating for project losses. Since the actual acquisition and restoration/improvement would have already taken place, using public funds, the dollar cost to the developer could be set such that it would represent the actual replacement cost of those resources lost and the funds thus generated would be applied to repay and reinstate the mitigation bank. Thus, not only would bank prices represent replacement costs but it would be self-sustaining and would facilitate mitigation in conjunction with even small-scale private developments, which generally lack the technical expertise and capital necessary to undertake an independent mitigation effort. The concept of mitigation banking can fit well into the context of estuarine management and if the initial problems of funding the bank and cataloging potential mitigation sites are overcome, this concept can provide an effective framework for the use of indemnification. The rather low ranking (sixth out of the ten approaches discussed) assigned to this approach within this paper reflects the effectiveness with which it has been applied to date. Applied within the mitigation bank framework, however, indemnification may be able to provide an entire new dimension to the process of estuarine mitigation.

g. Acquisition and Management. While simple acquisition of habitat does not constitute mitigation as defined above, a program of acquisition, in conjunction with wildlife or fisheries management, can, in some

cases, effectively mitigate project-related impacts. Mitigation of this form must result in the protection and management of enough of the remaining resources to increase the biological carrying capacity of an area, such that the productive capacity lost to any specific activity is compensated. Ultimately, the success of this approach is dependent upon two factors: the availability of manageable habitat and the ability to plan and carry out a successful management scheme.

The availability of manageable habitat may significantly affect the potential of this approach in mitigating impacts upon the estuarine environment. Given the distinct, geographical boundaries of estuarine systems, the pool of manageable, estuarine habitats will be physically limited, and since this approach involves the management of habitats within this pool, policy which favors its continual use in mitigation will result, ultimately, in a net reduction in management opportunity within the estuary. Although this does not reduce the viability of such an alternative, its use within physically limited, estuarine systems should be tempered by the knowledge that while compensating for a loss in productive capacity, it may also reduce future management options.

The success of an acquisition and management approach is linked to the development and implementation of an effective management scheme. Management efforts, however, often tend to be single-purpose and frequently attempt to stabilize estuarine systems rather than stressing the dynamic, natural fluctuations which may be essential to ecosystem function. Carlton (1979) has concluded that the United States can ill afford the kind of single-purpose acquisition and management which has been typical of mitigation programs in the past. Lands acquired for such mitigation must be managed for a mix of outputs, in order to ensure that mitigation does not fail to provide the range of resource values previously available. Farmer (1979) has also expressed concern over the success of this approach as applied to date:

"The certainties of project related, wildlife losses are generally greater than the certainties of maintaining a mitigation/management program because of the complications of continued funding, manpower availability and unforeseen, future, land use requirements."

This statement reflects the fact that the management component of such an approach is oftentimes inadequate or even nonexistent. The result is that losses are not fully offset. Insufficient funding for operation and maintenance (O&M) of the mitigation project is the primary cause of this deficiency and uncertainty concerning effective implementation of wildlife and/or fisheries management may limit the utility of an acquisition and management approach. Fish and wildlife losses that are project related should be mitigated at project expense and project appropriations should be inclusive of funding for O&M. Attempts by construction agencies or private developers to forego or deny responsibility for O&M funding and should be resisted. Not only should O&M funds be designated in conjunction with other project expenses but they should

increase if damages escalate or exceed projections. Follow-up studies to determine success and a program of strict enforcement are extremely important and should be a part of O&M funding. The need for O&M funding is fundamental to all forms of mitigation and does not require any new authority but merely that the construction agencies and Congress stand by their existing commitments regarding mitigation.

While this approach may, in certain cases, adequately mitigate for losses in estuarine productivity, its use in relation to private developments will be limited as a result of two facts:

- (1) Lacking the power of eminent domain, private developers may be unable to make the oftentimes significant acquisitions required.

- (2) Requiring private developers to make long term commitments to management may be difficult and, once made, such commitments may be difficult to enforce.

While this approach will not be beyond the implementation capabilities of all private developers, the regulatory agencies should be convinced that complete, fiscal commitment will be made, including funds for O&M and that private developers are not allowed to merely acquire mitigation lands and subsequently pass the responsibility for management to the resource agencies.

This approach has, in general, been well received by both resource and construction agencies. Presumably, the resource agencies possess the infrastructure to support such an approach, as they are, to a large extent, in the business of managing wildlife. Construction agencies, however, have viewed this approach as a method of foregoing acquisition costs by undertaking the management of currently existing public lands in the name of such mitigation. For example, Corps policy considers the management of existing public lands to be preferable to the acquisition of private lands for mitigation/management (Policy Paper, DAEN-CWR-P, 12 March 1980). Under current legislation, however, (e.g., Sykes Act and the Public Rangeland Improvement Act), all Federal lands are already mandated to be improved (i.e., managed) for wildlife purposes and to justify such action in the name of mitigation is simply an attempt to relieve an already existing Federal requirement. Therefore, development occurring on private lands should be mitigated on private lands, acquired specifically for mitigation.

Thus, although an acquisition and management approach can be applied usefully within the context of estuarine management, its effectiveness may be subject to several limiting factors. Furthermore, while acquisition and management may be capable of restoring productivity and maintaining system energy flows and biotic populations, it is incapable of restoring physical estuarine features such as surface area, specific tidal prism, and habitat diversity and continual reliance upon this approach could result in a long-term reduction in general environmental

quality. As a result, it should be relied upon only in the absence of other, more viable alternatives and only where its use can restore the ecosystem values lost as a result of development activity.

h. Tideland Alteration. Gonar (1979) has suggested the use of tideland alteration as a method of estuarine mitigation. This approach would center upon ecosystem components with naturally low values of productivity and diversity as compared with other system components. The objective of such an approach is to alter these low value habitats in a manner which results in tideland habitat that is of greater ecosystem value than the site subject to development and which is capable of compensating for the loss of that site. Appropriate tideland alteration might involve enhancement measures which are designed to increase primary production, detritus supply, and, thereby, system energy flows.

Gonar has also suggested some specific examples of tideland alteration that are of potential value in improving critical ecosystem processes and features and thereby capable of mitigating project-related losses. These will be summarized below:

(1) Depth Adjustment. Dredging areas subjected to accelerated sedimentation, toward the objective of increasing the total estuarine area at lower tidal levels.

(2) Substrate Alteration. Removal of silty, muddy, or polluted sediments which support a low diversity and abundance of species and replacement with clean material in order to enhance both subtidal and intertidal productivity.

(3) Increasing Intertidal Habitat Diversity. Alteration of tidal slope by removal or redistribution of bottom sediment toward the goal of increasing overall ecological diversity. Such alteration might attempt to increase the areal extent of low tidal heights, at the expense of more predominant, higher elevated habitat.

(4) Shoreline Adjustment. Excavating shoreline areas back in some places and extending it in others while controlling slope and creating desirable intertidal characteristics, a potentially effective method of increasing areal extent of higher tidal levels.

(5) Circulatory Enhancement. Excavation of tidal channels into mid to higher tidal levels such that circulation to these levels is enhanced and productivity and detrital exchange is improved.

These are just brief summarizations, and creative managers should be able to more fully explore the potential utility of these alternatives within specific estuarine systems. Their use, however, should lead to overall improvements in ecosystem function which are capable of mitigating project-specific estuarine impacts.

Many of the lands, submerged and intertidal, that would be subject to tideland alteration as a form of mitigation are state-owned (and in most instances, nonsaleable). This approach, therefore, will often require relatively little acquisition on the part of developmental interests and costs, in many cases, will be limited to those of the enhancement efforts themselves. Rather high uncertainty as to the outcome (e.g., increases in estuarine productivity, etc.) of such alterations, however, may prevent the resource agencies from granting their wholehearted support for these measures and a greater understanding of this principle is an undeniable requirement. While construction agencies may often view tideland alteration from the perspective of a developer, they will undoubtedly also express concern over the generation of additional (and perhaps contaminated) dredged material and the exacerbation of disposal problems. Emphasis upon regrading and redistribution of sediment, rather than removal, may lessen such concerns and increase the responsiveness of construction agencies to these proposals. Although more reliable, documentable, and feasible alternatives do exist, tideland alteration, properly planned and undertaken, is capable of addressing and effectively mitigating estuarine degradation and maintaining ecosystem function. As with acquisition and management, tideland alteration is incapable of restoring physical qualities of the estuary. However, while the former may often be single purpose, tideland alteration is based in the ecosystem concept and is an attempt to mitigate losses by improving overall estuarine function. Therefore, in cases where loss of surface area or other physical qualities are not at issue, tideland alteration should be given full consideration as a viable mitigation alternative.

i. Habitat Establishment. In search of new and innovative approaches to the concept of mitigation, habitat establishment has been proposed and generally recognized as an acceptable alternative. Habitat establishment is an attempt to compensate for developmental impacts through the active construction of alternative wildlife resources. The technology and methodology necessary in performing such constructive activities is currently available and two of these methods will be presented within this paper:

- (1) habitat establishment on dredged materials and
- (2) upland transformation.

While both of these methods may be successful in establishing functional habitat, their utility in the mitigation of estuarine impacts may vary significantly. The insinuation that dredged materials can be used "constructively" in mitigating estuarine losses is as controversial as it is intriguing and, for this reason, it will be discussed separately in a section to follow. Upland transformation, also of great potential within estuarine areas, will be discussed at this point.

Upland transformation is, in actuality, an attempt to expand the physical extent of an estuary through constructive activities. These activities are designed to alter the elevation of upland areas adjacent to the estuary, such that these areas are transformed into intertidal habitat. In establishing such habitat it may be possible to compensate for project-specific impacts, if the habitat thus formed is capable of developing into a functional component of the estuary. This may be done in one of two manners:

(1) excavation or lowering (i.e., "shaving") of estuarine shorelands or

(2) "shaving" island habitats (e.g., dredged material islands) or portions thereof, to intertidal levels.

In either manner, upland transformation will enable estuarine managers to effectively increase the water surface area, intertidal habitat, habitat diversity, total systemic productivity, and general environmental quality of the estuary. This approach is capable of mitigating the loss of critical ecosystem components by providing substitute resources to replace those lost or altered as a result of development activity. From the ecological perspective, this alternative presents an extremely viable option; not only can it provide for direct, in-kind replacement of lost resources but it ensures that the physical characteristics (e.g., water surface area) of the estuary will be maintained. This approach, however, may involve the destruction of currently existing upland wildlife resources and on such grounds, wildlife interests have often opposed the use of upland transformation. In general, however, barring the destruction of any unique shoreline habitat, the transformation of upland habitat to intertidal, estuarine habitat appears to be justifiable on productivity considerations alone.

Local interests have usually been rather vociferous opponents of this alternative and their argument appears to be based upon their aversion to any loss of valuable, developable, and, more importantly, taxable lands. In the overview, however, mitigation, effectively implemented, can serve to expedite development proposals and will not substantially reduce developmental opportunity. Furthermore, any real loss in local tax base can be recouped via a tax surcharge upon, or lump sum payment by, the developer. Of course, emphasis upon the transformation of dormant or marginally productive areas will minimize or prevent local opposition.

Additional opposition by natural resource agencies will, most likely, center upon the disposal of excavated materials. While the disposal of dredged materials is a universally recognized problem, the materials generated by such an "excavation" would not be of the same nature as dredged materials (i.e., silty, high water content, toxic, etc.) and would not entail similar disposal problems. Although some type of disposal site will be required, these materials should be more amenable to inland transport and conventional uses.

As an approach to fish and wildlife mitigation, upland transformation can ensure the maintenance of estuarine function, and although it has not yet been applied toward this goal, this is more a reflection upon the inadequacy of mitigation policy and mitigation planners than upon that of the approach itself.

j. Restoration. Restoration has been described by LaRoe (1979) as the rehabilitation and return of part of an ecosystem, formerly altered or removed, back to effective productivity. Thus, the objective of a restoration approach to mitigation is to offset developmental impacts by "recreating" high quality wildlife habitat where none or very little, currently exists. Such efforts may provide an excellent opportunity to mitigate estuarine losses and within estuarine areas such efforts may include:

- (1) the removal of fills,
- (2) shoreland vegetation planting to reestablish buffer areas,
- (3) breaching abandoned and deteriorating dikes,
- (4) removal of man-induced pollution stress,
- (5) habitat alteration to restore former depths and circulation/flushing patterns within parts of the estuary, and
- (6) removal of deteriorating structures (e.g., pilings, wharves, buildings).

These efforts center upon past alterations and attempt to compensate for damages caused by current activity by rehabilitating areas subject to alteration in the past. One of these alternatives - breaching of diked tidelands - is of particular value and will be discussed in more detail.

In the past, many wetland areas throughout the United States have been diked, drained, or filled and the fish and wildlife resources supported by these valuable habitats have been displaced by agricultural, residential, commercial, industrial, and other human uses. From 1849 to 1979, 300 square miles of San Francisco Bay intertidal habitat was reduced to 50 square miles. This activity has left over 100 square miles of former wetlands available for restoration (Sorenson, et.al., 1979). These are wetlands previously altered by diking, draining, or filling but which now lie dormant. Opportunities such as this exist in virtually all estuarine and riparian environments and mitigation for the loss of wetland areas can often best be accomplished by restoring some of the vast wetland acreage previously altered for human use.

Sapa (1979) has described the process and theory leading to the adoption of an extensive wetland and grassland restoration plan in relation to the construction of the Garrison Diversion Unit, North Dakota. The

revegetation and reestablishment of Colorado River riparian wetlands have been discussed by Anderson and Ohmart (1979) and wetland restoration is currently being considered as perhaps the primary avenue for future mitigation efforts within San Francisco Bay and all of California's coastal areas (Jim McKeivitt, FWS, personal communication).

The use of other restorative options, especially those relating to the curtailment of pollution stress, may suffer from what is perceived by the agencies as an inability to implement such plans. When such alternatives are proposed, the typical lead agency response will often be "beyond our ability to implement." This, however, is often a self-imposed constraint and the agencies should instruct their planners that this phrase has no place in the planning process. Agency responsibilities, in mitigating fish and wildlife losses, are not to increase business but to provide the most objective, expert analysis possible (Houck, 1980). If the lead agency is unable to implement the most effective plan, it should channel the necessary funds to that organization which has the required capability. If that organization refuses to implement the plan, the constraint upon the lead agency then becomes legitimate and it should proceed to a secondary alternative.

In order to most effectively mitigate fish and wildlife losses, restorative efforts should emphasize the reestablishment and maintenance of natural habitat complexes and/or physical regimes. By returning habitat to the use of natural communities, this form of mitigation can consider all affected species and avoid a myopic, single-dimensional approach. Often such mitigation will entail only simple engineering tasks and in the case of diked or drained wetlands, may require only removal of the dike itself or filling of drainage canals. Once this is accomplished, wetland vegetation begins to return almost immediately (Sapa, 1979). Restoration will usually require neither substantial acquisition nor long-term commitments to management and, thus, may be more realistically applied to private development and permit regulation. This approach to fish and wildlife mitigation can be both cost and ecologically effective and since outcomes are highly predictable, available options should receive emphasis during mitigation planning.

This discussion, in following a general course from what are perceived to be unacceptable and ineffective approaches to those that are considered viable and preferable, has intended to provide the reader with a framework upon which mitigation options can be evaluated in a qualitative sense. This framework involves several questions which are stated below and a negative response to any of these questions could, theoretically, lead to the elimination of that approach at the level of estuarine policy:

(1) Is the approach capable of addressing the full range of project-specific impacts?

(2) If successfully implemented, will the alternative provide for the maintenance of ecosystem values and benefits?

(3) Is actual implementation of the option likely to be incomplete or are anticipated results highly uncertain and controversial?

Managers should look upon the conclusions of this analysis as a series of general and highly qualitative recommendations. They are, however, recommendations which are fundamental to the formulation of viable estuarine policy on mitigation.

In developing an estuarine-specific policy, resource managers should attempt to make a clear distinction among regulation, planning, and mitigation. Regulation is an attempt to avoid unacceptable impacts; planning attempts to eliminate unnecessary or avoidable impacts; and mitigation compensates for resultant losses which are expected to occur despite regulatory and planning activities. The most direct manner in which to make such distinctions is by adopting an explicit definition such as that proposed above. Although this definition is restrictive, it is open-ended and would allow virtually any activity which is capable of addressing and offsetting developmental impacts. As this section has attempted to prove, these are useful exclusions and the definition is not overly restrictive.

In addition to expressly distinguishing mitigation from regulation and planning, estuarine policy should identify mitigation alternatives which are nonacceptable, conditionally acceptable and preferable within the context of the estuary in question and overall estuary management objectives. An example of such guidelines might be as follows:

(1) Nonacceptable Alternatives: approaches that are inconsistent with or incapable of fulfilling the objective of maintaining ecosystem processes, function, and productivity:

- (a) public use tradeoffs,
- (b) simple acquisition (i.e., preservation), and
- (c) single-purpose enhancement.

(2) Conditionally Acceptable Alternatives: approaches that are not inconsistent with ecosystem-oriented objectives but that are generally incapable of fulfilling those objectives in and of themselves:

- (a) indemnification,
- (b) acquisition and management, and
- (c) tideland alteration (multipurpose enhancement),

(3) Preferable Alternatives: approaches consistent with ecosystem objectives and involving highly certain and predictable outcomes:

(a) indemnification (applied within the framework of a mitigation bank),

(b) upland transformation (i.e., specialized habitat establishment), and

(c) restoration of previously altered habitats.

Under the guidance of specific estuarine policy, which is inclusive of explicit definitions, objectives, and guidelines, resource managers will be able to more successfully apply the concept of mitigation to estuarine losses and to fit mitigation plans within the context of system-wide management objectives.

West Coast Precedent In Estuarine Mitigation

In light of the preceding section and its attempt to identify acceptable approaches to estuarine mitigation, it may now be useful to move into a discussion of the mitigation policy which has evolved within the coastal and estuarine areas of the Pacific Coast States. Washington, California, and Oregon have, in many respects, emerged as leaders and innovators in the field of coastal zone management; their policy is often emulated by other coastal states and their experiments in coastal and estuarine mitigation are proving to be no different. Within this section an effort will be made to familiarize the reader with the policy and policy objectives existent within these states and to identify the approaches which are, under such policy, considered to constitute acceptable mitigation. This presentation will also facilitate an analysis of the exclusions and recommendations presented above, in light of currently operative, state level policy.

a. Washington. Of the three Pacific Coast States, Washington's mitigation policy is the least developed; in fact, this state has no formal policy on fish and wildlife mitigation and the Washington Shorelines Management Act of 1971 (the statutory basis of the state's federally approved coastal zone management program) alludes to mitigation only in the broad regulatory and planning sense. Despite the absence of state level policy, however, mitigation activities have been required in conjunction with both public and private development within Washington's coastal and estuarine areas. This mitigation has been facilitated largely through the efforts of state level resource agencies - primarily the Departments of Game, Fisheries, and Ecology - but in the absence of legislative authority and guidance, these agencies have failed to develop any formal mitigation policy or objectives and can only "require" mitigation by working in conjunction with FWS within the Federal permitting process; efforts, therefore, are piecemeal, inconsistent, and frequently ineffective.

Each of the categorized approaches discussed earlier has been applied, to varying degrees, within Washington's coastal zone but none, with exception to regulatory and planning approaches, is pursued as a course of normal agency policy. Thus, mitigation requirements in Washington can be expected to vary, on a case to case basis, as they have in the past. The extent of variation will depend largely upon the administrative skill, knowledge, persistence, and philosophy of individual actors within the mitigation process. Moreover, there is no essential difference in how the State of Washington views coastal versus inland mitigation, unless such a difference is the result of a particular individual's philosophy. In general, coastal mitigation in Washington occurs ad-hoc and piecemeal and although mitigation is often required, the concept is applied inconsistently and its success may vary significantly from case to case.

b. Oregon. During the development of Oregon's federally approved coastal zone management program, the Oregon Land Conservation and Development Commission (LCDC) recognized the importance of the concept of mitigation to the effective management of the state's estuarine ecosystems. As a result, Oregon's mitigation policy has evolved as the most ecosystem specific and perhaps the most exacting of any in the nation. It is one, however, which has yet to be fully implemented.

Originally conceived as an enforceable, statewide planning goal (Statewide Planning Goals and Guidelines: Goal 16, Estuarine Resources), Oregon's requirement called for mitigation by creation of, or replacement with, areas of "similar biological potential." Mitigation of this form was to provide an area that would, with time, develop a qualitatively and quantitatively similar flora and fauna. The criterion of "similar biological potential," however, was difficult to define and the Oregon policy has recently (1979) been transformed into a formal statute (Oregon House Bill 2619). Oregon's Coastal Management Program is currently being updated to include the total of this statute (Kvarsten, 1980).

House Bill 2619 also deals specifically with estuarine resources and defines mitigation as an activity which proceeds as a part of a permitted alteration and when considered in conjunction with the negative impacts of the alteration, results in no net loss of estuarine values (Kvarsten, 1980). Within Oregon, mitigation can be accomplished through the restoration of a previously altered resource, the creation (i.e., establishment) of a new resource, or the enhancement of an existing resource. In addition, the Oregon guidelines indicate those activities which are not considered to constitute mitigation: the transfer of estuarine lands to public ownership, their dedication to natural uses, single-purpose measures (e.g., artificial propagation), or the payment of funds for research and/or land acquisition. As did its predecessor, House Bill 2619 requires compensation for the adverse effects that will result when any fill or removal occurs in the intertidal or tidal marsh areas of an estuary. The objective of this requirement is to ensure the

maintenance of functional characteristics and properties of the estuarine ecosystem, such as natural biological productivity, habitat and species diversity, unique features, and water quality.

The Oregon requirement is supplemented by a series of implementing regulations which list three basic priorities to follow in choosing a mitigation site. From highest to lowest, the priorities are:

(1) areas in general proximity to the dredge or fill site, as proximate areas will generally have the greatest potential to develop in a similar manner, with the same basic relation to the entire estuarine system;

(2) areas offsite but possessing similar physical characteristics to the altered site (e.g., salinity regime, tidal exposure, substrate type, hydrodynamic regime, solar exposure, and slope); and

(3) areas or resources which are presently in the greatest scarcity compared to their past abundance and distribution.

Thus, Oregon's mitigation policy recognizes the importance of in-kind and onsite considerations but remains flexible to case specific requirements and system-wide management objectives.

c. California. The mitigation experience of this coastal state is more complete than that of any other and mitigation programs are currently being implemented in all of California's coastal and estuarine areas. The California Coastal Act of 1976 contains specific policy relative to the mitigation of impacts upon coastal ecosystems; "where development is allowed in coastal waters or wetlands, mitigation measures shall, at a minimum, include either acquisition of equivalent areas of equal or greater biological productivity or opening up equivalent areas to tidal action; provided, however, that if no appropriate restoration site is available, an in-lieu fee sufficient to provide an area of equivalent productive value or surface area shall be dedicated to an appropriate public agency, a replacement site purchased by the public agency, and restoration begun before the project may proceed" (California Coastal Act, Section 30607.1).

While the California policy identifies onsite or near-site mitigation alternatives as the most preferable, it emphasizes replacement of natural productive capacity rather than strict, in-kind replacement and encourages . value for value compensation as opposed to more traditional acre-for-acre tradeoffs. Thus, California has adopted a compensation philosophy of mitigation and the stated objective of this policy is to ensure that necessary development occurs in a manner which "maintains or enhances the functional capacity of the ... estuary (California Coastal Act, Section 30233(c))." Mitigation efforts, therefore, are designed to accommodate desirable, economic activity, such that the coastal resource,

subject to severe alteration in the past, remains "whole" in the face of development and that necessary modifications do not result in the disruption of ecosystem function and productivity.

In addition to adopting ecosystem-based policy and objectives, the California legislation identifies specific approaches which are considered to be consistent with this policy; restoration, habitat establishment, acquisition and management, and indemnification have all been utilized during implementation of California's mitigation requirement. While each of these approaches have been applied in the past within California, it is the restoration of diked and/or drained wetlands which now appears to evoke the most enthusiasm from mitigation planners. Although both habitat establishment and acquisition and management have also been applied successfully, they now appear to constitute secondary alternatives. This secondary status does not necessarily reflect any inability of these approaches to fulfill mitigation goals but, rather, is primarily representative of the abundance of restorable resources, highly certain outcomes, and the relative cost effectiveness of a restoration approach. Indemnification, sound in theory, has never been considered successful as applied in California, presumably because of a failure on the part of the state to exact the replacement costs which are called for in the Coastal Act. At the present time, this approach is not generally pursued, except in cases in which options are severely restricted; in the future, however, given the proper framework (e.g., mitigation banking), in-lieu payments may significantly enhance implementation of California's mitigation requirement within estuarine environments.

d. Regional Estuary Management Plans. The development of an effective, ecosystem based mitigation policy has been called for throughout this paper and this section has identified two states - California and Oregon - which have begun to develop and implement such policy; since the estuary is a distinct and definable coastal resource, an impetus has developed along the Pacific coast toward the development of far-sighted, regional estuary management plans. Such plans involve the formulation of region wide policy and management objectives for the estuary in question and provide an excellent forum for the development of strong and ecosystem specific mitigation policy. This has, in fact, been the case within both California and Oregon where the development of estuarine policy has been guided by precedent at the state level. Although regional estuary planning is also occurring within Washington, the same type of ecosystem based policy does not appear to be forthcoming.

Currently, there are two major estuary planning activities in progress within the State of Washington; the first involves Grays Harbor, a large and economically important estuary along the state's Pacific coast. Upon the insistence of Federal resource agencies, a regional planning process has been undertaken but in the the management plan there is no mitigation policy. It has been the contention of the Grays Harbor Estuary Task Force (GHETF) that mitigation has been considered on a

long-term, planning perspective and that by planning for future land and water uses, the management plan will reduce developmental impacts. Thus, in the absence of precedent in Washington law and any substantial pressure from state or Federal guidance, the policy process within Grays Harbor has produced nothing more innovative than the good planning approach discussed above. Such policy does not consider or address project-specific impacts and cannot ensure that ecosystem processes, functions, and productivity will be maintained. Some, however, consider this general planning approach to be a welcome departure from the typical case-by-case, permit-by-permit approach. However, the inconsistency, nonpredictability, and costly delays which they seem to admonish are not, in fact, the result of case-by-case application of the concept; rather, fault usually lies in the lack of explicit policy guidance and the piecemeal applications which result.

To the south of Grays Harbor, within the Columbia River estuary, the second of Washington's major estuary planning activities is occurring. This is a cooperative, interstate planning effort, involving counties of both Washington and Oregon and conducted by the Columbia River Estuary Taskforce (CREST). The CREST planning document has essentially adopted, intact, the Oregon policy of compensatory mitigation. Under the CREST program, therefore, several Washington counties have the opportunity to adopt strong, ecosystem based policy but their compliance with this particular segment of the plan is not compulsory. In fact, one Washington county has already indicated that it will not adopt the mitigation provisions of the plan, and without a greater effort on the part of Washington State and the Federal agencies involved, this tendency can be expected to continue (personal communication, Mike Delapa, CREST)

Although it is questionable, at this time, whether effective, ecosystem based mitigation policy will be adopted at the estuarine level within Washington, it should be evident that a regional management framework can provide the medium for the development of such policy. Development and adoption of mitigation policy has been precluded, largely, by the lack of precedence within Washington law and the neutral stance taken by the state and Federal agencies. Regional planning, in this context, is an attempt to forge a long-term decision framework which will guide future development in an attempt to eliminate unnecessary impacts. Mitigation policy, like planning, should be a component of a comprehensive estuary management plan and in the absence of specific state requirements, its use should be encouraged by both the state and Federal agencies involved.

While mitigation occurs within estuarine areas of all the Pacific Coast States, the policy foundations in each state are quite diverse. With no formal policy, Washington's efforts at mitigation are undertaken piecemeal and are often inconsistent. Although California and Oregon have different policy foundations, their basic philosophy, one of compensatory mitigation, is similar. With the implementation of the compensatory policies of these two states, it is becoming apparent that such

mitigation is economically and ecologically feasible within the coastal and estuarine environment. This specific policy will encourage consistency, predictability, coordination, and most importantly, emphasis upon the maintenance of not only natural biological productivity but also of ecosystem relationships. In addition, it will encourage the development of similarly viable policy at the regional and local level.

Mitigation and Dredged Material Disposal: Innovation or Desperation?

Under provisions of the Rivers and Harbors Act of 1970, the Corps of Engineers was authorized to conduct an extensive research program designed to address problems related to the environmental effects of dredging. The Dredged Material Research Program (DMRP) was led by the U.S. Army Corps of Engineers Waterways Experiment Station (WES) and one of its major objectives was to develop viable disposal alternatives, including consideration of dredged materials as a manageable resource. One of the "constructive" uses studied under the DMRP was the establishment of wildlife habitat (e.g., fresh and salt marsh) on dredged material. The development of this capability has led some to conclude that habitat establishment offers both a biologically productive disposal alternative and an effective method of mitigating fish and wildlife losses incurred as a result of water resources development projects (Hunt, 1979).

To the Corps of Engineers, which dredges approximately 305 million cubic yards of sediment annually, such a disposal alternative is obviously attractive. Substantial controversy exists, however, concerning the viability of wetland establishment as an acceptable mitigation option; this controversy is fueled, primarily, by an overwhelming lack of information and hence, uncertainty concerning the long-term, ecosystem effects of wetland establishment on dredged material and its ability to yield net productivity benefits which can offset project-related losses. This section will generally discuss the process of wetland establishment on dredged material, identify informational barriers to its use, and make recommendations as to its potential in mitigating losses of fish and wildlife within the estuarine environment.

a. Establishment of Estuarine Habitats on Dredged Material. In the past, the disposal of dredged material within estuarine systems has often resulted in the inadvertent establishment of wildlife habitat. The specific type of habitat thus established was a function of several physical factors such as elevation, exposure, and substrate composition; various estuarine habitats, including islands, marshes, mudflats, and grassbeds have been established in this manner. In Washington's Grays Harbor, opportunistic marsh plants invaded former disposal sites around Rennie Island and now form a rather extensive salt marsh. Kellogg Island, formed by dredged material disposal within Seattle's Duwamish Waterway, is an artificially created oasis of "natural" estuarine habitat in the midst of a highly industrialized urban environment. The island now supports adjacent intertidal wetlands somewhat representative of those found within the once expansive Duwamish estuary.

Although functional estuarine habitat has been established via dredged material disposal in the past, such establishment was completely fortuitous. Wetland establishment now being explored as a disposal alternative by the Corps involves the strategic placement of dredged material such that appropriate physical factors are attained and the desired wetland (i.e., one critical to ecosystem function) is established. In several experimental projects to date, the Corps has been successful in establishing salt marsh habitat using dredged material. However, the value of this "technology" in mitigating fish and wildlife losses remains uncertain.

b. Informational Requirements and the Effects of Uncertainty.

While wetland establishment implies a constructive utilization of dredged material, it also involves the destruction of currently existing estuarine habitat, as intertidal or subtidal benthic habitat is covered. In actuality, such an approach constitutes a planned substitution of one type of habitat for another, rather than the creation of "new" estuarine habitat; its utility in mitigating project-related losses depends, therefore, upon the ability of mitigation planners to identify and establish habitat which is both more productive, acre for acre, and of equivalent or greater value in ecosystem function than the originally existing habitat. Thus, effective use of wetland establishment as an approach to estuarine mitigation will require some rather detailed information regarding ecosystem function.

In order to predict the long-term ecosystem effects of wetland establishment on dredged material, it is necessary to know the relationship of both habitats ("new" and "old") to the entire estuarine ecosystem. Given this information, one could predict "with" and "without" project (i.e., establishment) effects upon fish and wildlife habitat, primary productivity, water quality, and the export of nutrients and detritus to the estuarine system. Such information, however, while seemingly fundamental, may be inaccessible, especially within west coast estuaries where surprisingly little is known of the relative values of wetland types (high marsh, low marsh, mudflat, etc.) to ecosystem function.

The estuarine economy is fueled by a diverse flow of nutrients and energy. Managers of estuarine systems should attempt to maintain the critical components of this energy flow and thereby maximize the productivity and value of the ecosystem. In many estuarine systems the primary productivity of salt marshes may be the single most critical factor in the maintenance of ecosystem function, as these components may be largely responsible for the amount of nutrients and energy flowing through the system to its biotic communities. However, in other estuaries, such as those of the northwest, salt marshes may not be the driving force of ecosystem function. To the contrary, there appears to be good evidence that within northwest estuaries, the contribution of salt marshes to ecosystem productivity may be extensively overshadowed by that of intertidal mudflats. The algal mats covering these mudflats are prodigiously productive and provide virtually all of their biomass to

the estuarine system (personal communication, Jeff Gonar, Oregon State University). However, the literature on the relationship of wetlands to the function of northwest estuaries is virtually nonexistent, and generalized application of "east coast ecology" and literature to the management of northwest estuaries may foster ineffective management. Thus, while in theory a policy of strategic wetland establishment may, in fact, over the long term, result in a more productive and valuable estuarine system, inability to sufficiently document this theory will dampen its viability as a mitigation alternative.

c. Loss of Estuarine Water Surface. In addition to the problems caused by a lack of conclusive information regarding ecosystem function, the utility of wetland establishment as a mitigation option may be reduced due to its effect upon estuarine water surface area. LaRoe (1979) and Gonar (1979) have expressed concern for any loss in estuarine water surface. Gonar concludes that:

"Most major estuarine ecosystem features are surface related: plant production, water-atmosphere gas and heat exchange, light reception, nutrient regeneration and total habitat space are all directly proportional to (water) surface area.... Retention of surface area minimizes reduction in tidal flushing capacity, an important property to conserve in estuaries with intensive development. Minimizing surface area reductions will certainly buffer the estuarine system as a whole from irreversible degradation."

Furthermore, while wetland establishment on dredged material would be an acceptable alternative under Oregon law, it has been expressly discouraged within the CREST document (Section 62.20):

"Disposal of dredged material in water and wetland areas for the specific purpose of creating shallow water, intertidal or island areas is strongly discouraged because this practice contributes to the downward trend of available aquatic habitat."

It is important, therefore, that consideration be given to surface dependent estuarine functions during mitigation planning. Moreover, efforts should be made to ensure that losses to estuarine surface area, attributable to establishment activities, are identified and if sanctioned, that they do not result in or contribute to a long-term decline in general ecosystem quality and productivity.

d. Restoration of Habitat Diversity. Over the past century, developmental activity has substantially altered and/or reduced the diversity of habitats within most estuarine areas and produced a diversity that is neither natural nor planned. This loss of diversity has resulted in a general decline in the quality of estuarine systems. While it is

neither possible nor desirable to return the estuary to pre-nineteenth century conditions, the restoration of habitat diversity is an important management objective (CREST plan, Section 62). In this interest, attempts are being made within many estuaries to restore the "natural" diversity of habitats which, presumably, is that ratio of habitat types that would have occurred in the absence of human intervention. The establishment of wetlands on dredged material is seen by many as a means towards such an objective. While the establishment of salt marsh or other wetlands can be used effectively in moving toward what is perceived to be a more "natural" or beneficial diversity, such considerations should not be allowed to dominate the decision process. While restoration of diversity is a desirable management objective, the objective of mitigation remains to be the maintenance of ecosystem function by addressing and compensating for project-specific impacts. Thus, although restorative efforts such as the removal of diking can be effective in mitigating fish and wildlife losses, the restoration of habitat diversity, even though it may be one of the end results of a mitigation effort, should not be overemphasized in an attempt to legitimize this or any other approach to mitigation. In the absence of viable, in-kind mitigation options, the Oregon policy of mitigating out-of-kind by turning to those resources most adversely affected by past human activity appears to be quite useful. The ultimate mitigation objective, however, remains unchanged: to compensate for project specific fish and wildlife losses.

In conclusion it would be inappropriate, given the current state of knowledge, to make any blanket endorsement or condemnation of wetland establishment on dredged material as a mitigation option. Rather, the potential that such an approach may improve the ecological quality of the estuary in question requires that it be considered in mitigation planning. As long as an approach has the potential to address and offset the impacts at issue, there is no inherent characteristic of any one option that technically removes it from consideration prior to examination.

In order to facilitate more effective mitigation in the future, resource managers should search for a greater variety of options, such that a wider range of alternatives may be presented to prospective developers. In many cases, strategic placement of dredged material may possess the potential to improve overall ecosystem function (provided that loss of surface area is not significant) and to meet overall management objectives (e.g., restoration of habitat diversity) and, thus, to mitigate project related impacts. Inability to provide sufficient documentation, however, will limit the marketability of this alternative and if it is to be utilized successfully, the Corps of Engineers must produce reliable information on the relative contribution of the established wetland to total ecosystem function.

Conclusions

Mitigation is a management concept which is broadly applicable within a wide array of disciplines; within each, however, successful implementation requires a unique conceptual and institutional framework. In recent times, mitigation has begun to develop as a tool in the conservation of the nation's fish and wildlife resources but due to an overwhelming lack of firm policy guidance, the concept of fish and wildlife mitigation has been widely misunderstood and misapplied. Ineffective application of this concept is especially disturbing within estuarine environments, where successful mitigation of fish and wildlife losses is critical to the attainment of long-term, management objectives.

Although mitigation policies are urgently needed in estuarine areas such policy has, to date, been adopted only at the state level. In adopting and implementing a compensation philosophy of estuarine mitigation, California and Oregon are showing that such policy is economically and ecologically feasible, but similarly effective policy has not yet arisen within other coastal states nor at the Federal level.

Formulation of estuarine-specific policy at the Federal level is important for two reasons. First, given the ability of Federal agencies, through the Corps' regulatory program, to regulate virtually all activities within or affecting estuarine systems, such policy would facilitate more effective, consistent, and predictable application of the concept within these critical environments. In addition, such policy would help to ensure that the functional capacity of the nation's estuarine resource is maintained without displacing desirable economic activity. Moreover, strong state, regional, or local policy may simply encourage the movement of economic activity into the estuarine areas of states without such policy, while effective policy at the Federal level could be consistently applied within all estuarine systems. Secondly, such policy at the Federal level would, undoubtedly, provide useful precedent which would exert a positive influence upon policy development and estuarine management in all estuarine areas. Hopefully, this paper has illustrated the fact that a firm and explicit mitigation policy in relation to the fish and wildlife resource in general and, more specifically, in relation to the estuarine environment, would be invaluable additions to the nation's natural resource policy.

Those charged with the difficult task of developing an estuarine-specific mitigation policy should first ensure that explicit statements of definition and objective are used to address the issue of what constitutes mitigation (i.e., questions of nature and degree). This policy should be inclusive of specific guidelines which indicate both acceptable and non-acceptable approaches, identify and rank preferable options (i.e., in-kind, out-of-kind, onsite, offsite), and thus be capable of effectively guiding implementation decisions at the field level. In addition (but not discussed herein), mitigation policy should include broadly

applicable criteria for evaluation of mitigation efforts. Most importantly, however, estuarine policy on fish and wildlife mitigation should be developed from an ecosystem perspective, emphasizing the maintenance of ecosystem functions, processes, and relationships.

A compensation philosophy of mitigation is realistic and workable within the context of the estuarine environment and several viable approaches to the mitigation of estuarine losses are currently at the disposal of estuarine managers. In addition, new and innovative, but as yet untested, alternatives are being proposed and with the removal of informational barriers and, thus, uncertainty concerning outcome and success, alternatives such as habitat alteration and wetland establishment on dredged material could become "marketable" approaches within estuarine systems. No solutions will be easy or inexpensive and, ultimately, estuarine developers and the consumers of the goods and services which these developers produce will have to pay the price. By internalizing environmental costs into the developmental decision process, however, such a policy will allow more informed decisions concerning development to be made and will ensure that desirable economic activity fits, compatibly, into the estuarine environment.

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The Western Interstate Commission for Higher Education

The Western Interstate Commission for Higher Education (WICHE), located in Boulder, Colorado, is a compact organization serving regional higher education needs in the 13 western states: Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming. During its 25-year history, it has provided projects in higher education in a number of areas: professional student exchanges, health and human services, criminal justice, minority programs, and student internships.

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- . We recruit qualified students for the agency's selection of final intern(s);
- . We assume responsibility for the accounting/bookkeeping functions which relate to internships, i.e., payment of weekly stipends, intern travel reimbursements, costs of publishing reports, liability insurance for students;
- . We assist students to locate resource materials for the conduct of their project;
- . We print intern reports and distribute them to agencies, depository libraries in the West, and others interested in reports;
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